

Beyond Objects:

Using Machines to Understand the Diffuse Universe

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The second New York Workshop on
Computer, Earth, and Space Sciences
NASA Goddard Institute for Space Studies
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Objects in Space

Our Diffuse Universe

Machines <3 Objects

A Case Study: The HI ISM

Current Problems

It Gets Worse

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NATIONAL
GEOGRAPHIC

Photograph by Chris Perry

YOUR SHOT: THE DAILY DOZEN
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Objects in Space

Our Diffuse Universe

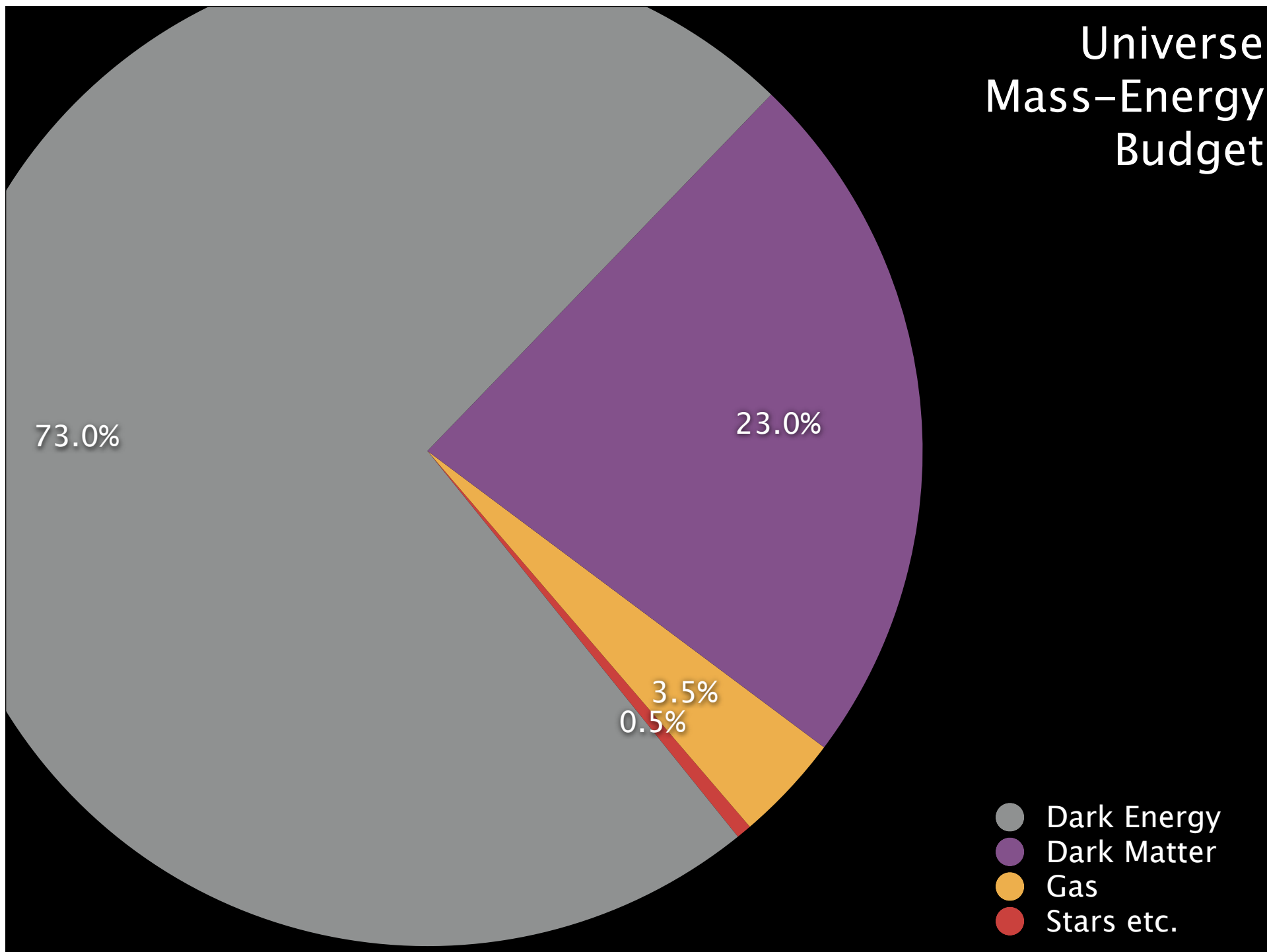
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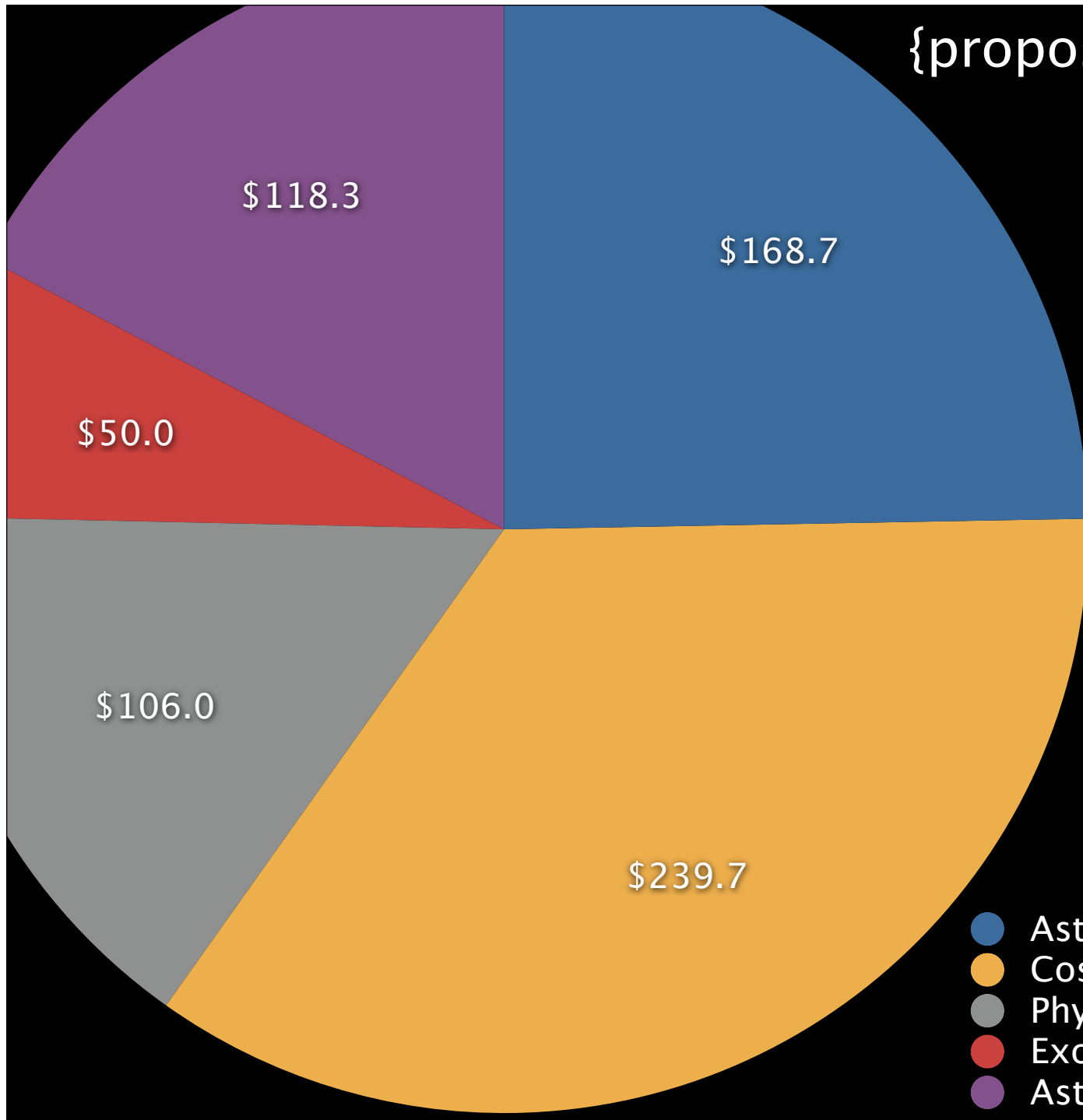
Current Problems

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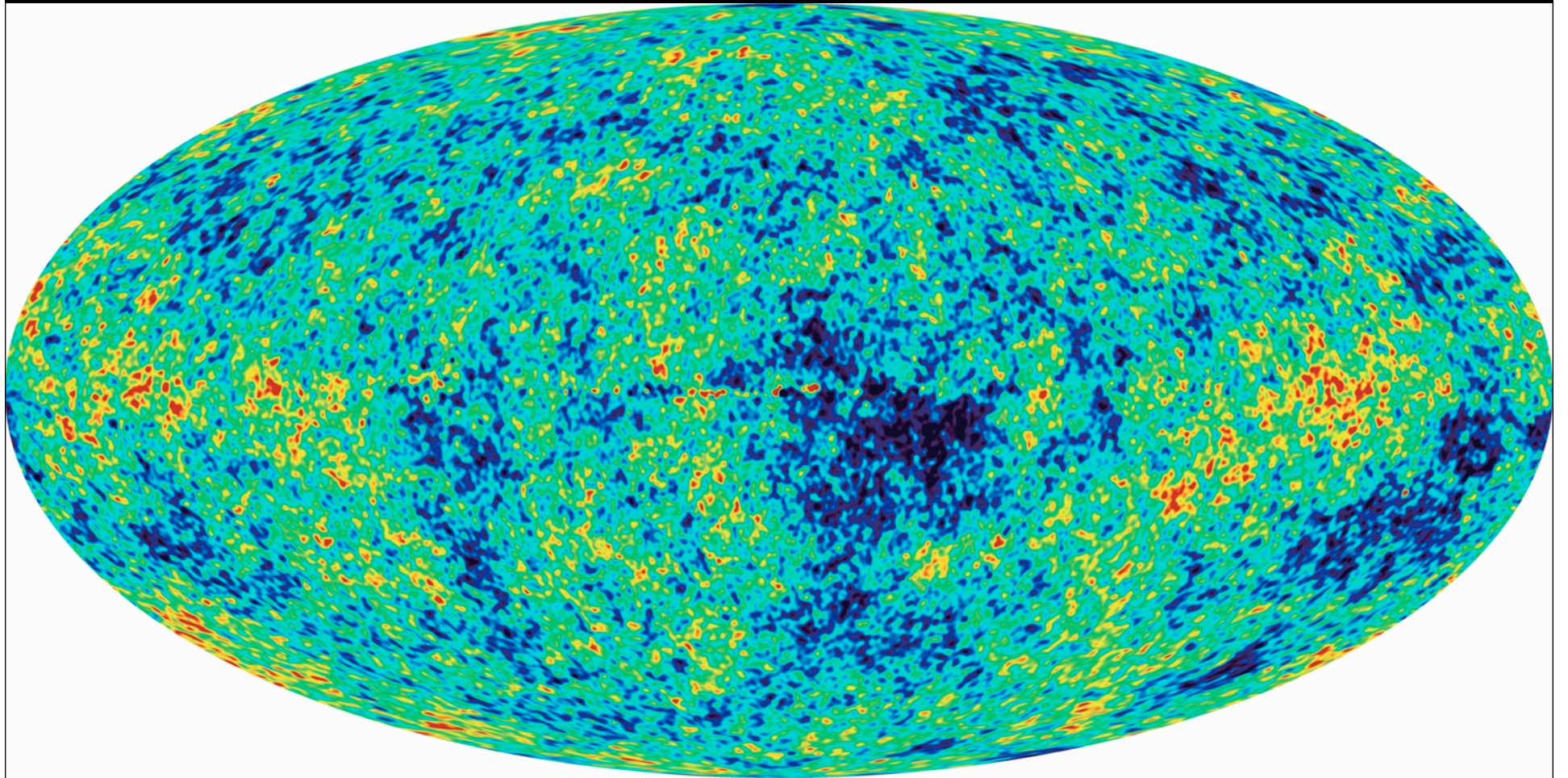
Universe Mass–Energy Budget



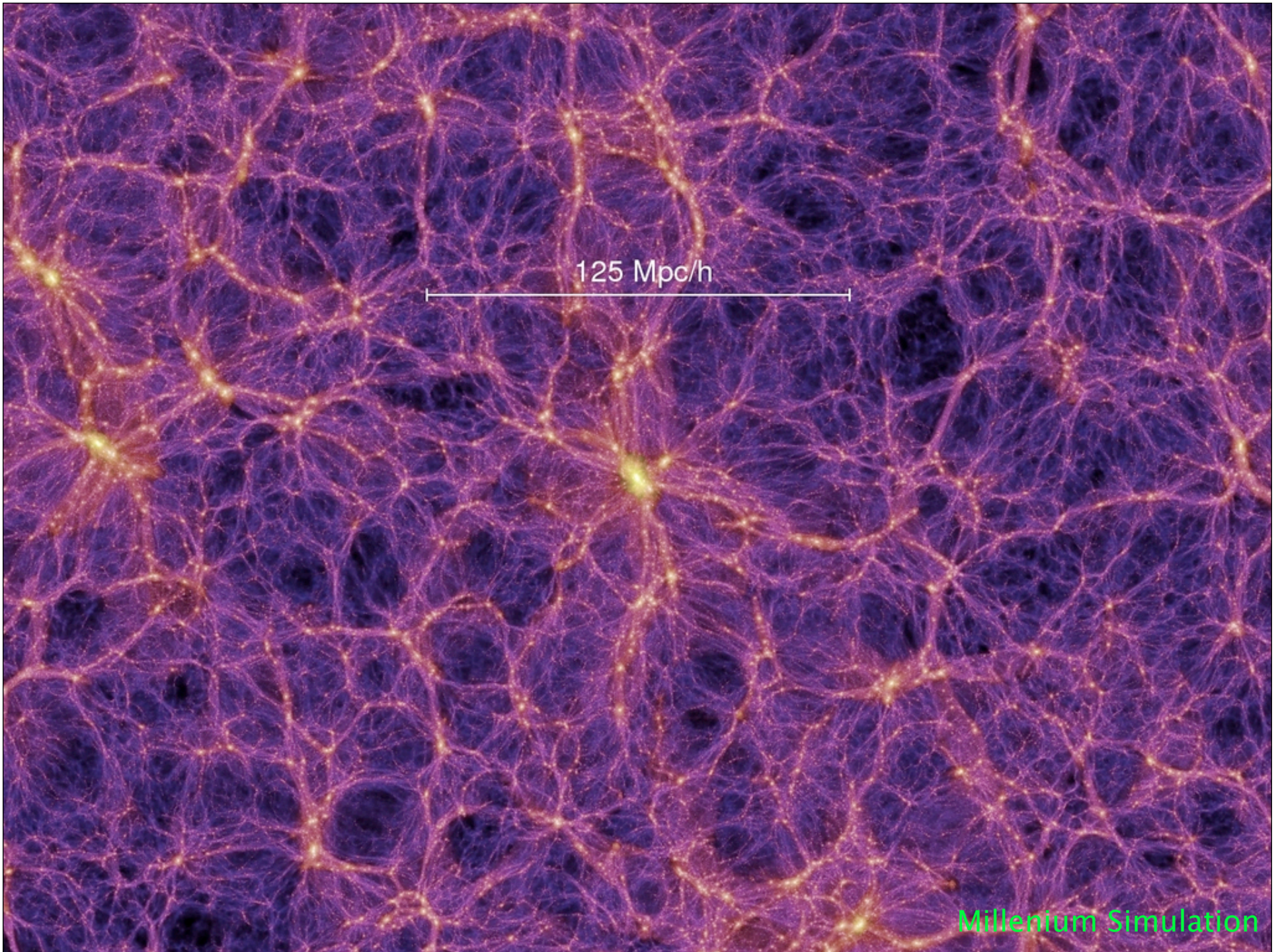
{proposed} NASA 2012
Astrophysics
Budget

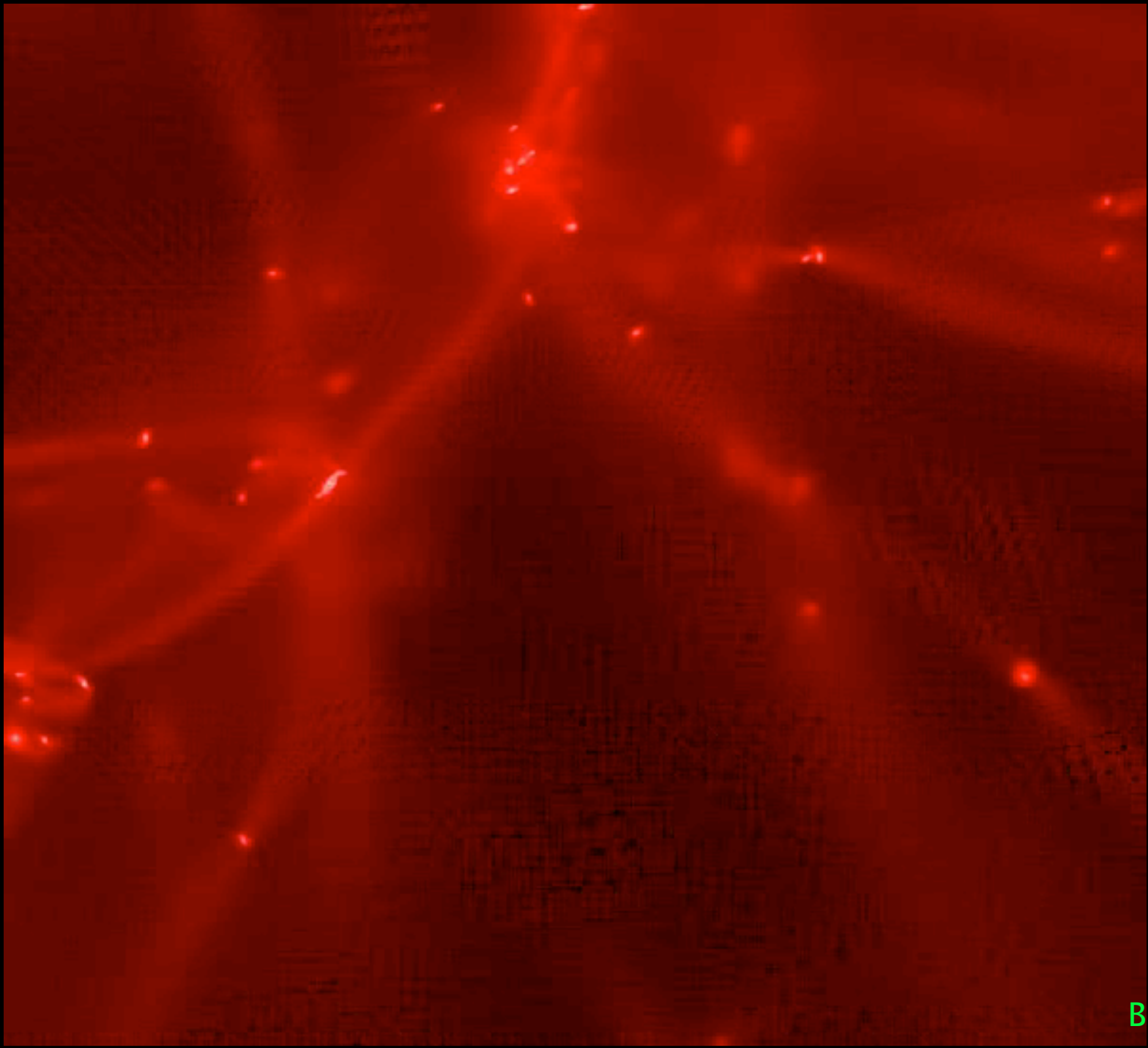


- Astrophysics Research
- Cosmic Origins
- Physics of the Cosmos
- Exoplanet Exploration
- Astrophysics Explorer

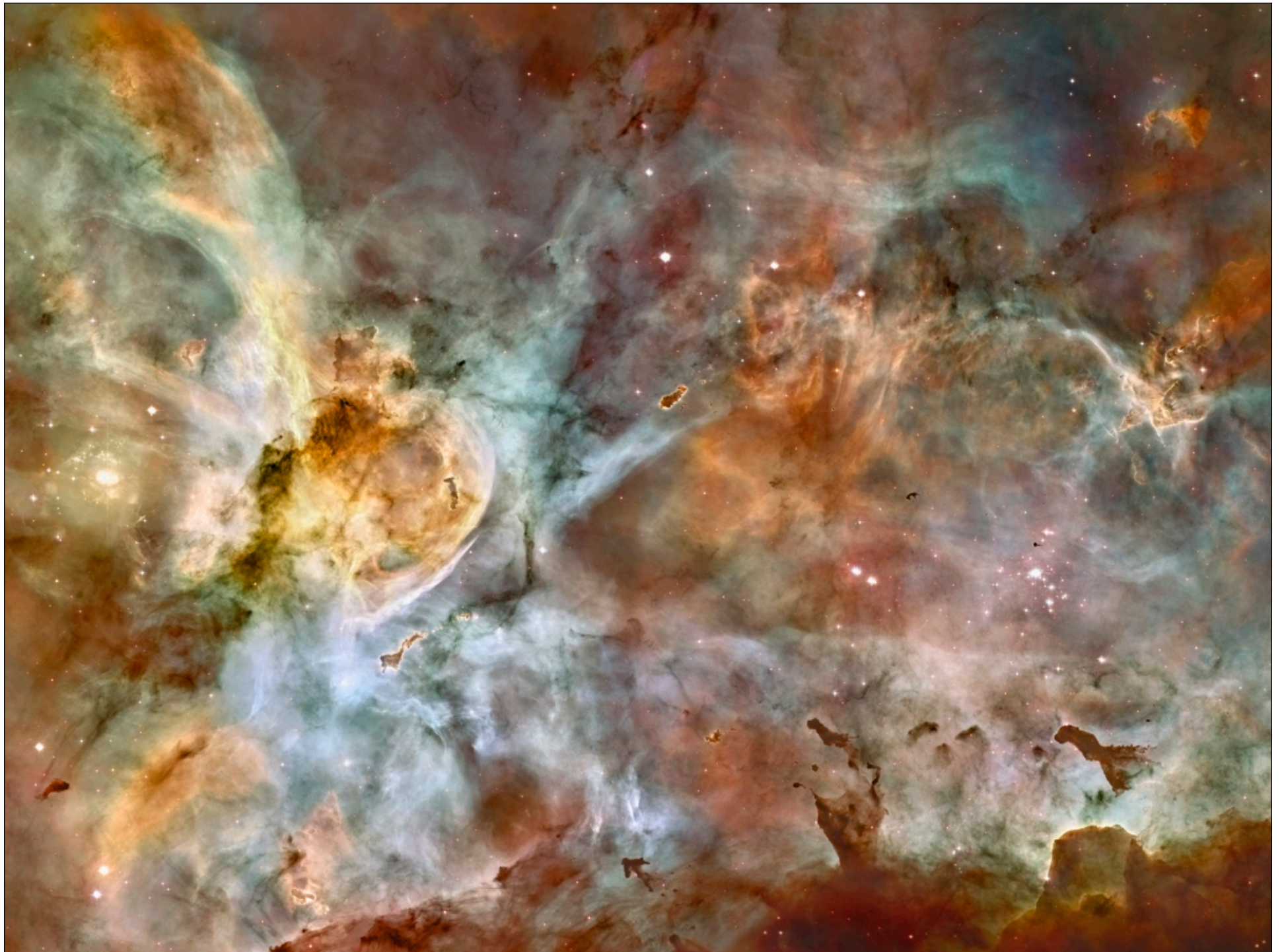


WMAP





Bryan+







Objects in Space

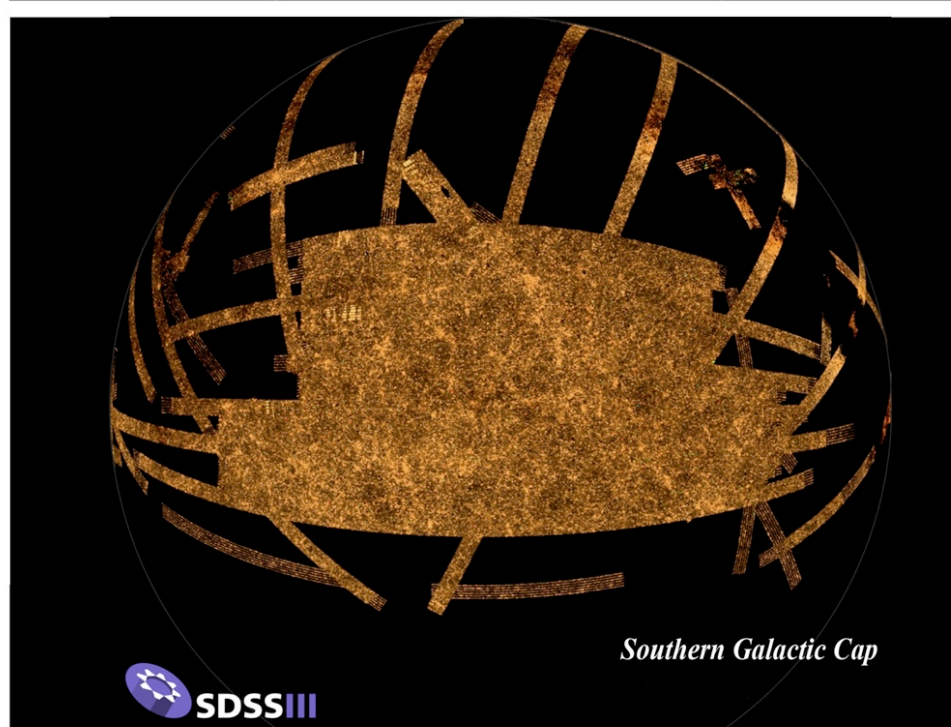
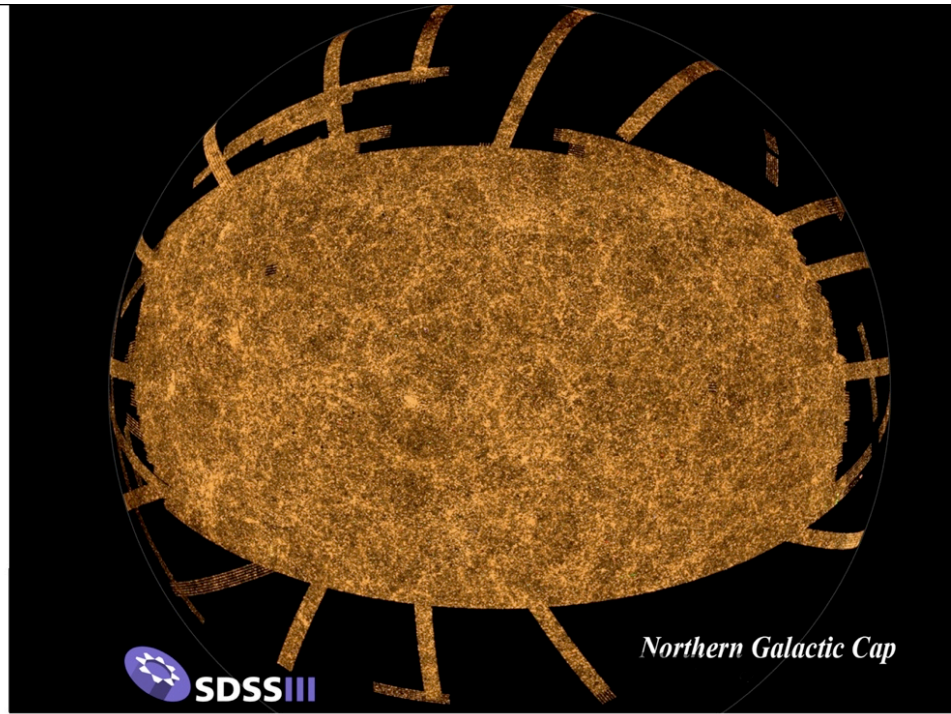
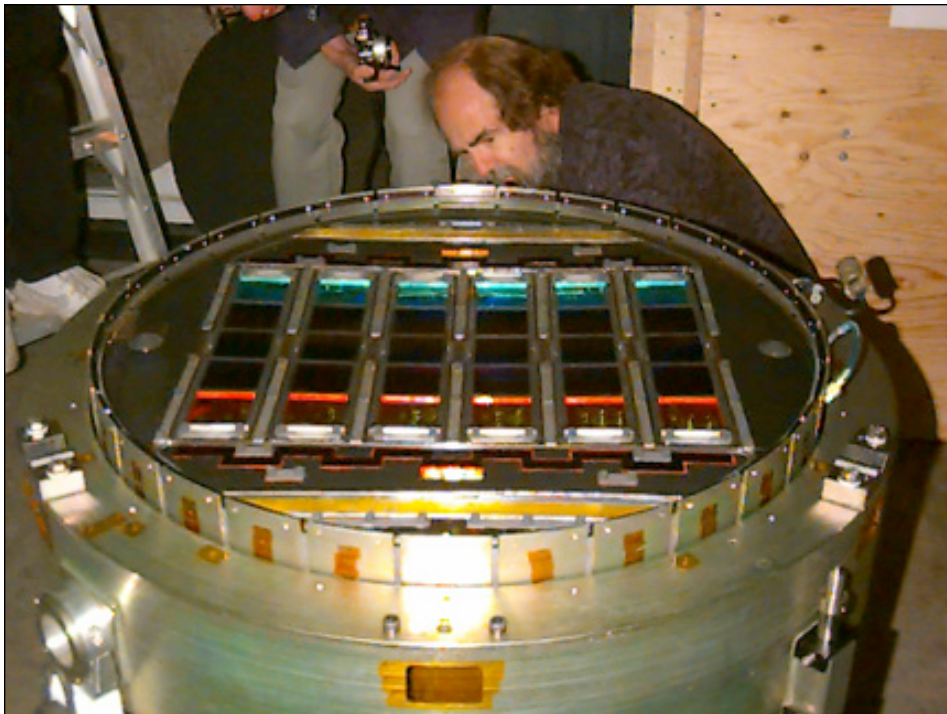
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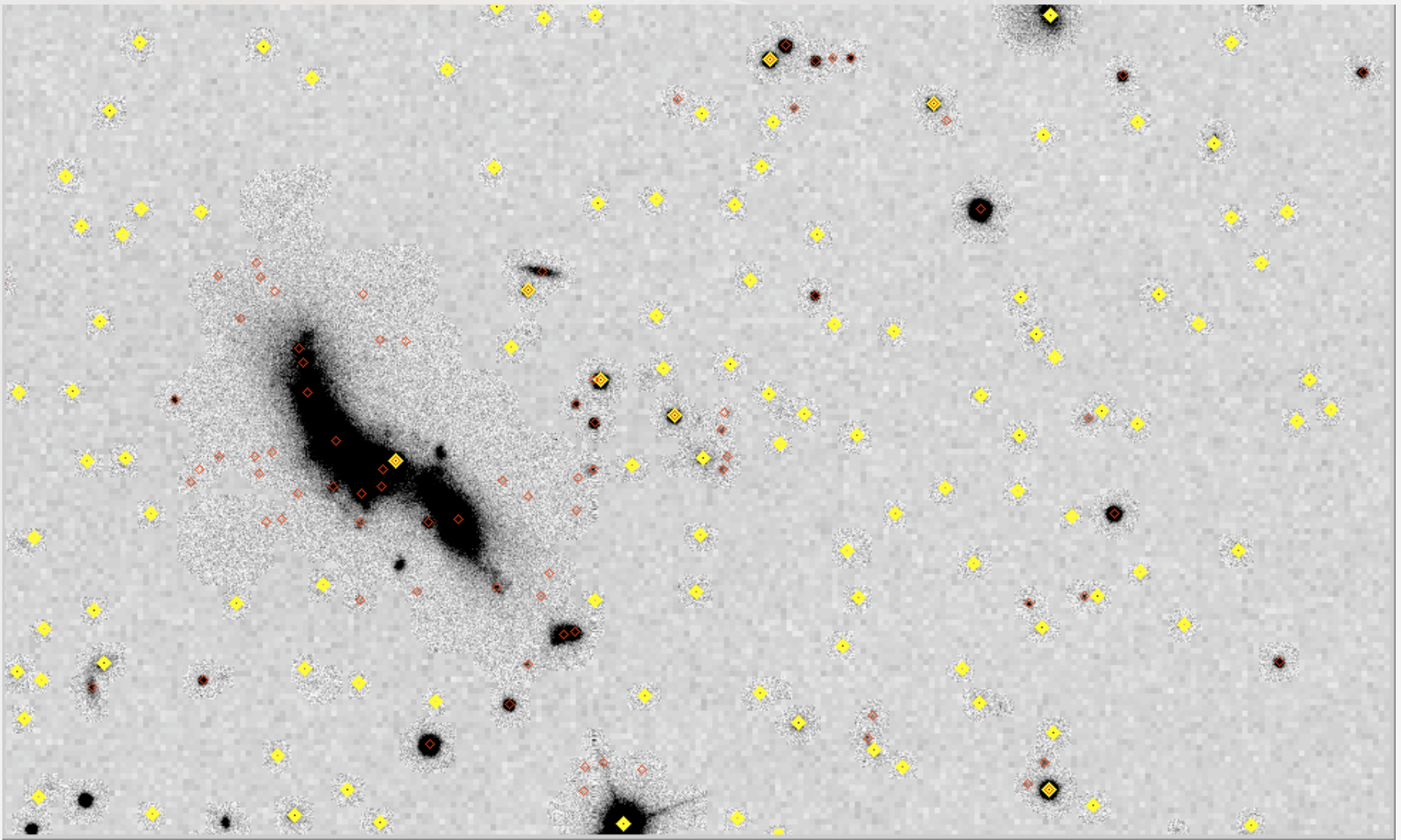
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Parents and children



photoObj quantities

http://data.sdss3.org/datamodel/files/BOSS_PHOTOOBJ/RERUN/RUN/CAMCOL/photoObj.html

Type & quality tags:

objc_type (int16): Type classification of the object (star, galaxy, cosmic ray, etc.)

0 (OBJ_UNK): An object of unknown type.

1 (OBJ_CR): Not used.

2 (OBJ_DEFECT): Not used.

3 (OBJ_GALAXY): Object is classified as a galaxy

4 (OBJ_GHOST): Not used.

5 (OBJ_KNOWNOBJ): Not used.

6 (OBJ_STAR): Object is classified as a star

7 (OBJ_TRAIL): Not used.

8 (OBJ_SKY): Empty part of the image designated for sky.

objc_flags (int32): photo object attribute flags (see <http://www.astro.princeton.edu/~rhl/flags.html>)

objc_flags2 (int32): Second set of photo object attribute flags

fracDeV[5] (float32): Weight of deV component in deV+Exp model

psf_fwhm[5] (float32): PSF FWHM (arcsec)

Flux tags:

psfMag[5] (float32): PSF magnitude (mag)

psfMagErr[5] (float32): PSF magnitude error (mag)

psfFlux[5] (float32): PSF flux (nanomaggies)

psfFluxIvar[5] (float32): PSF flux inverse variance (nanomaggies)

best #s for point sources

petroMag[5] (float32): Petrosian magnitude (mag)

petroMagErr[5] (float32): Petrosian magnitude error (mag)

petroFlux[5] (float32): Petrosian flux (nanomaggies)

petroFlux_Ivar[5] (float32): Petrosian flux inverse variance (nanomaggies)

*model-independent galaxy fluxes
(good for $r < 19$ or so)*

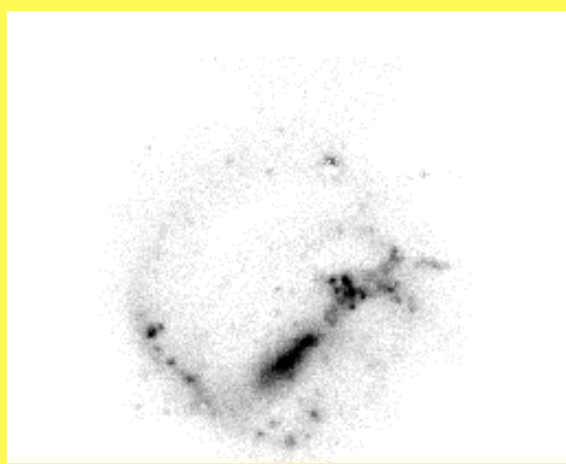
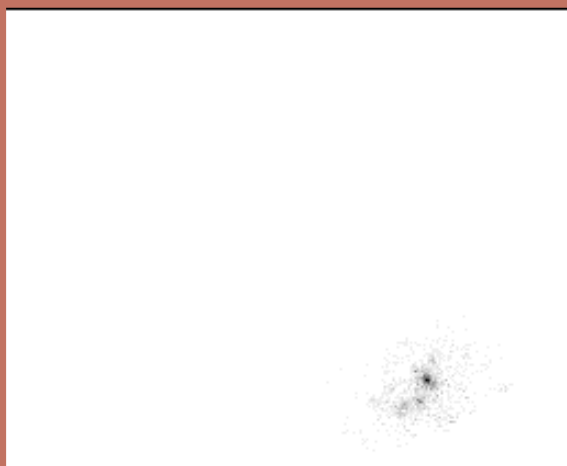
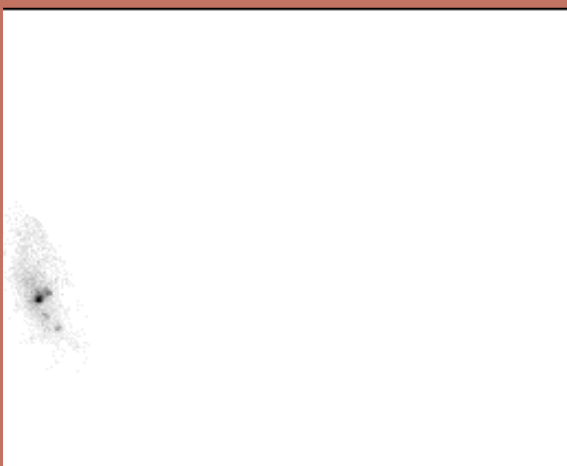
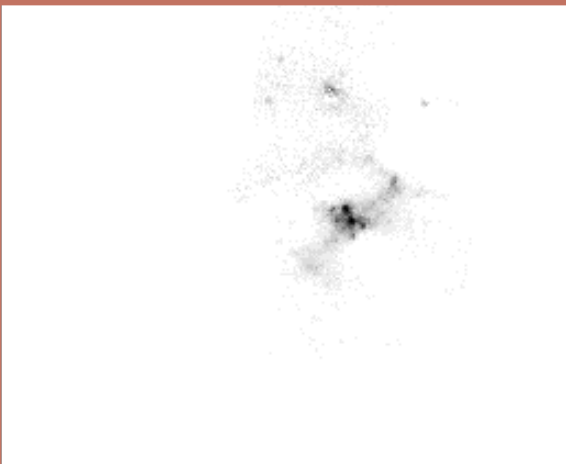
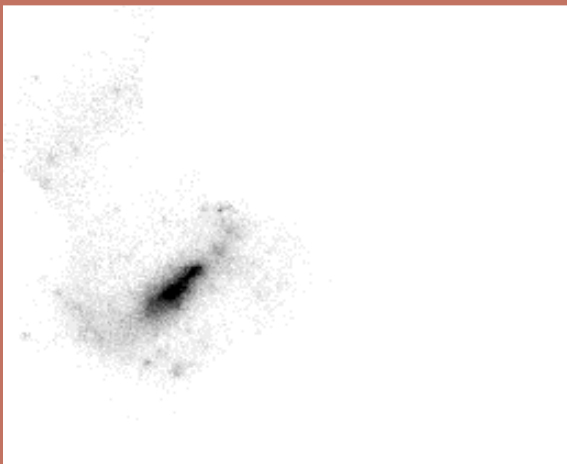
cModelMag[5] (float32): DeV+Exp magnitude (mag)

cModelMagErr[5] (float32): DeV+Exp magnitude error (mag)

cModelFlux[5] (float32): better of DeV+Exp flux (nanomaggies)

cModelFlux_Ivar[5] (float32): Inverse variance in DeV+Exp flux fit (nanomaggies)

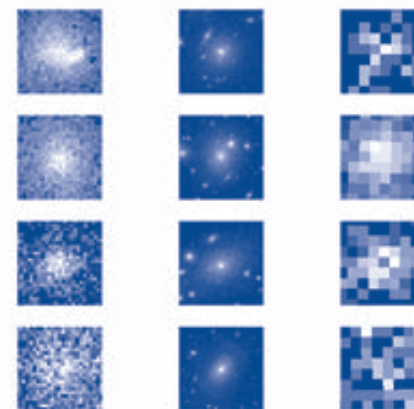
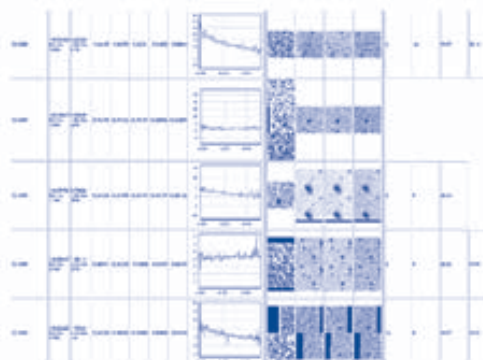
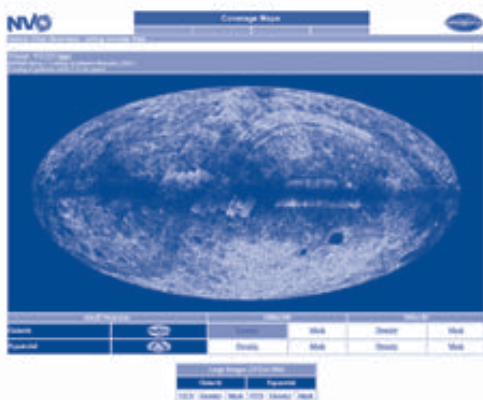
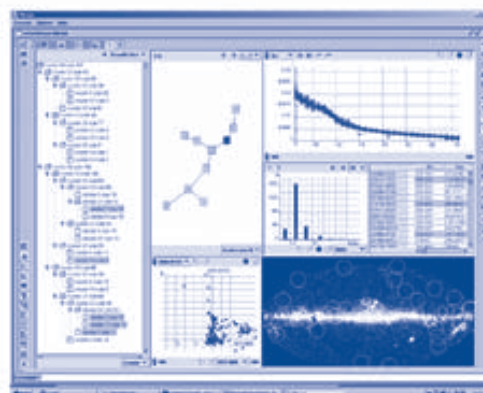
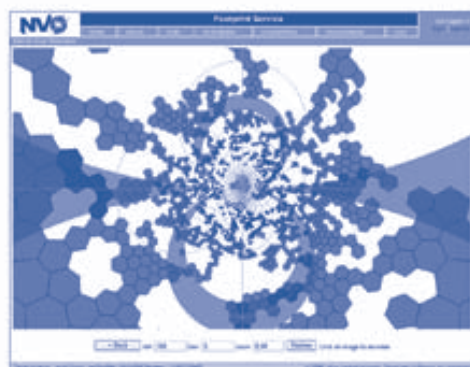
best #s for faint galaxies

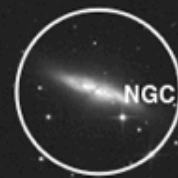


West+ 2010

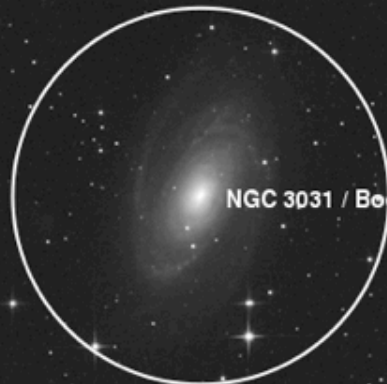


NATIONAL VIRTUAL OBSERVATORY





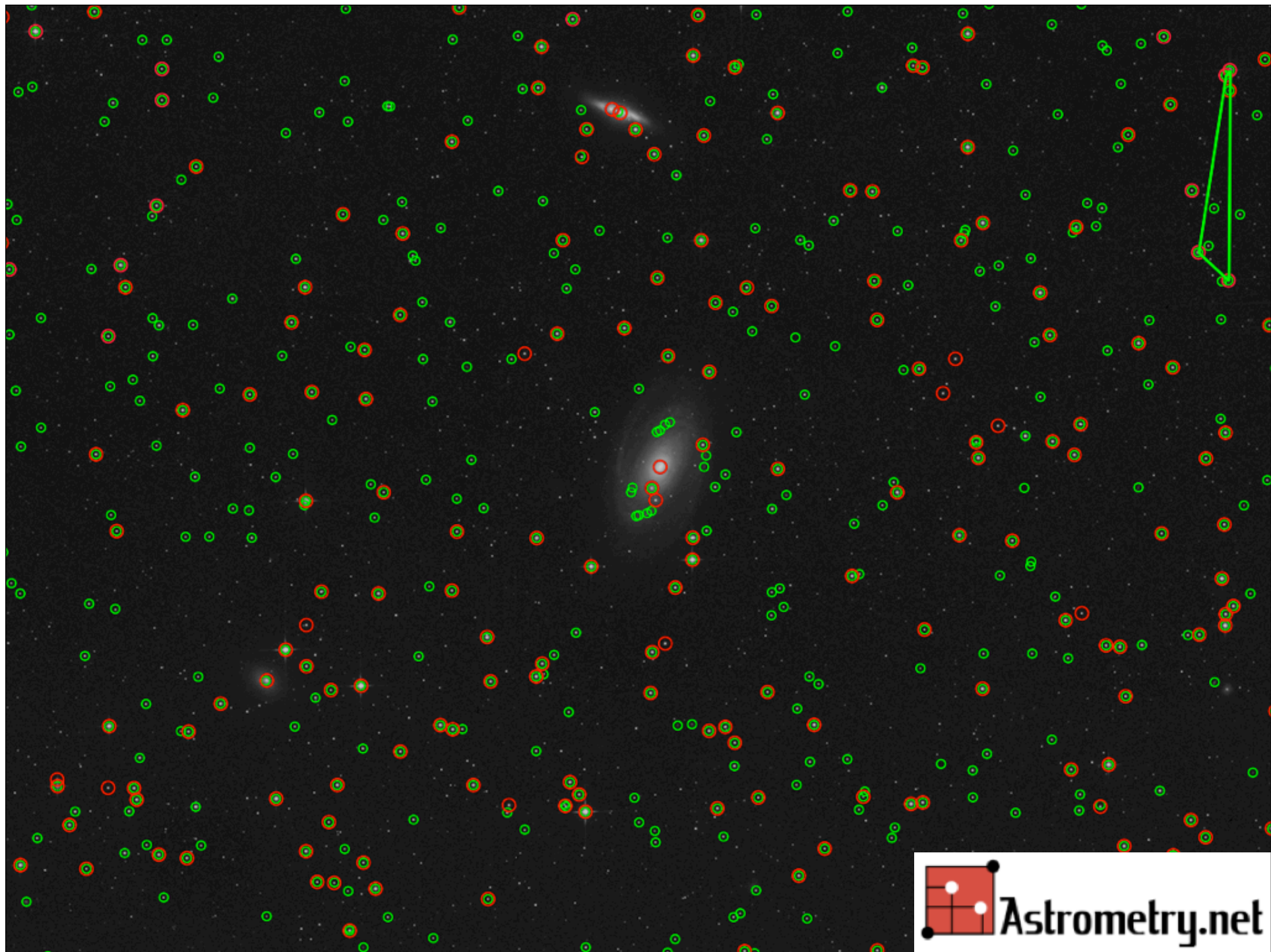
NGC 3034 / Bode's nebulae / M 82



NGC 3031 / Bode's nebulae / M 81



NGC 3077



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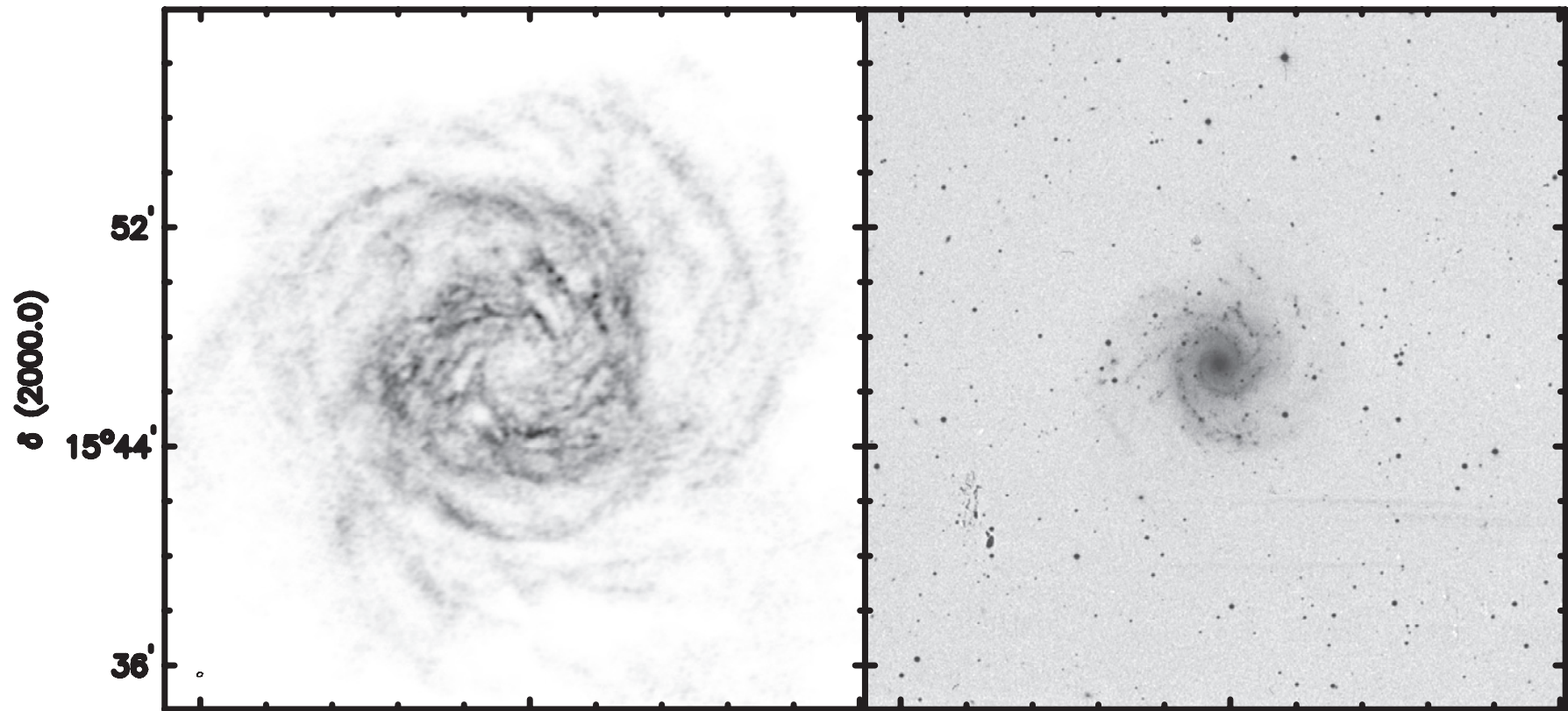
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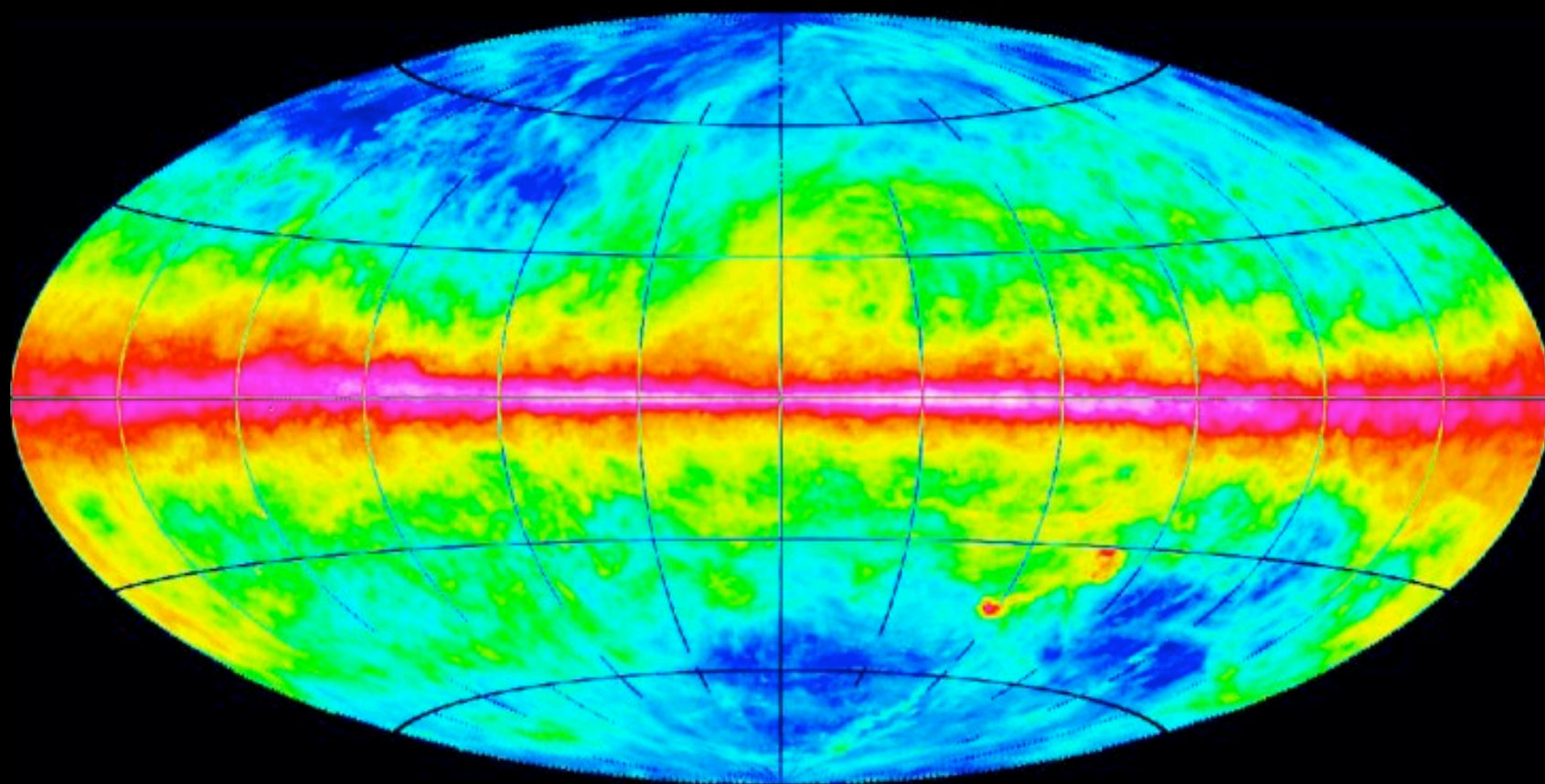
Current Problems

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NGC 628



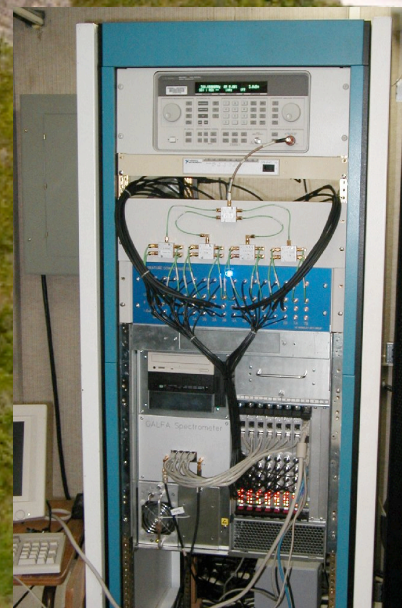
Walter+ 2008

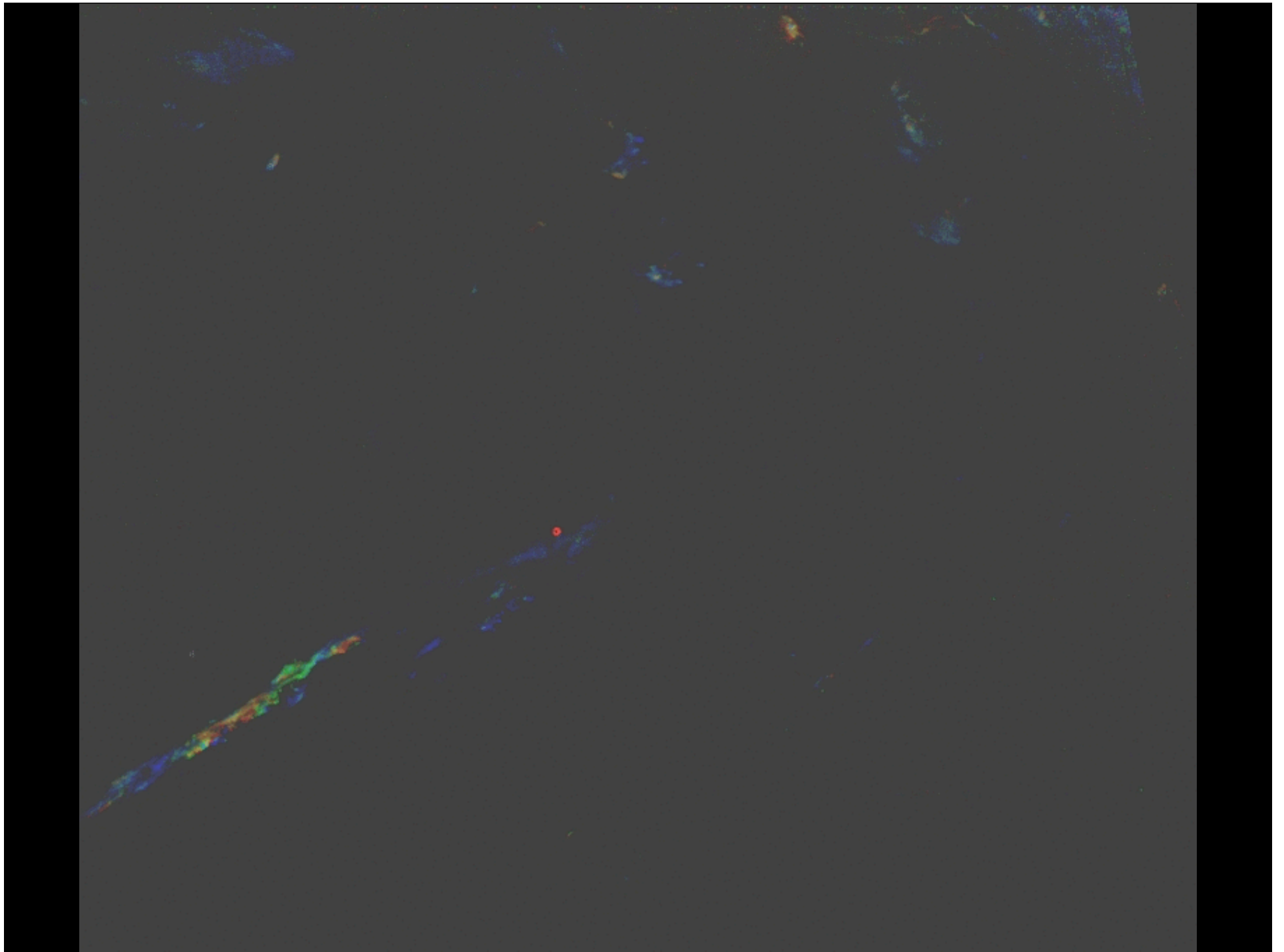


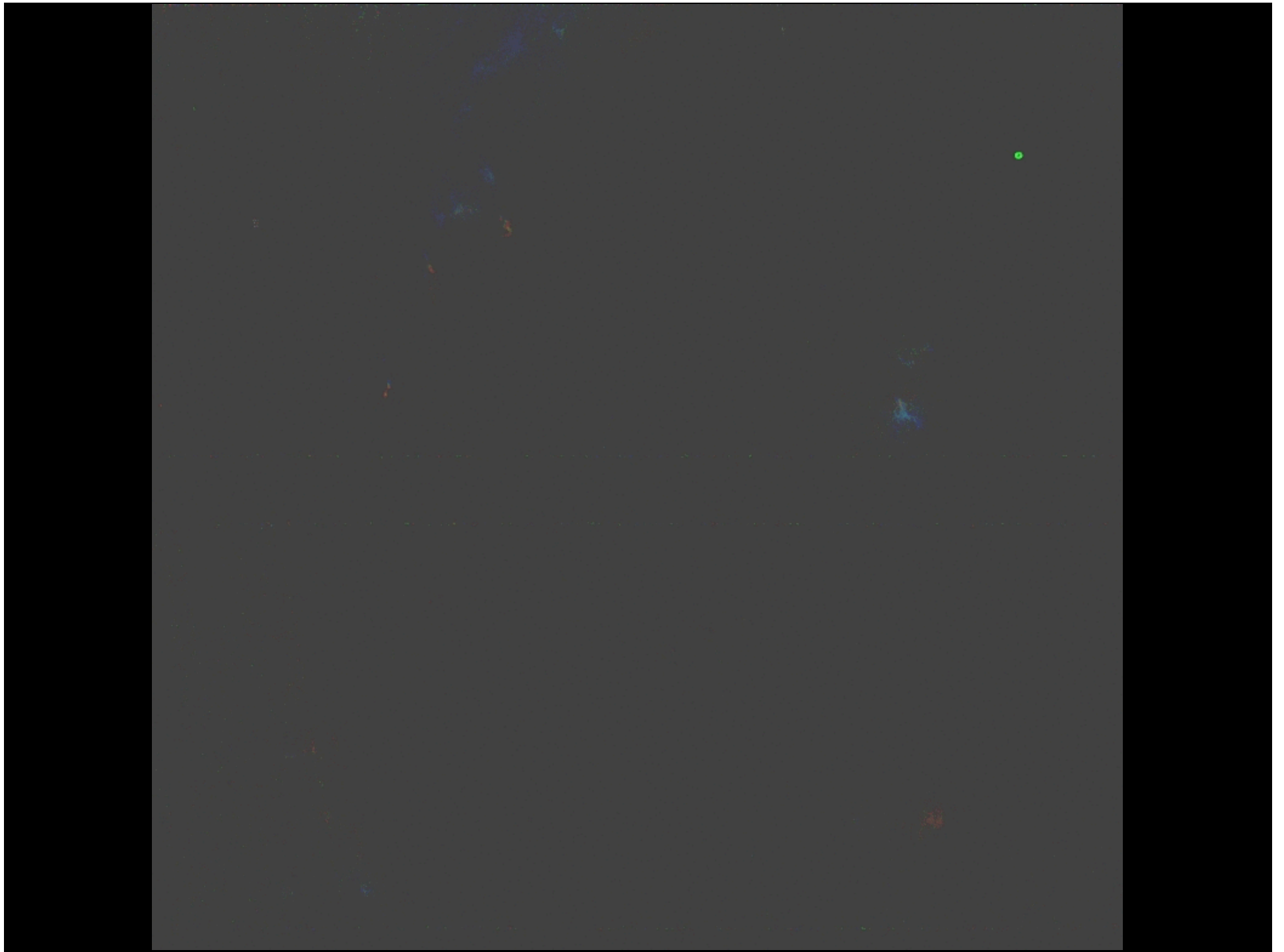
Arecibo 305 m

ALFA

GALSPECT

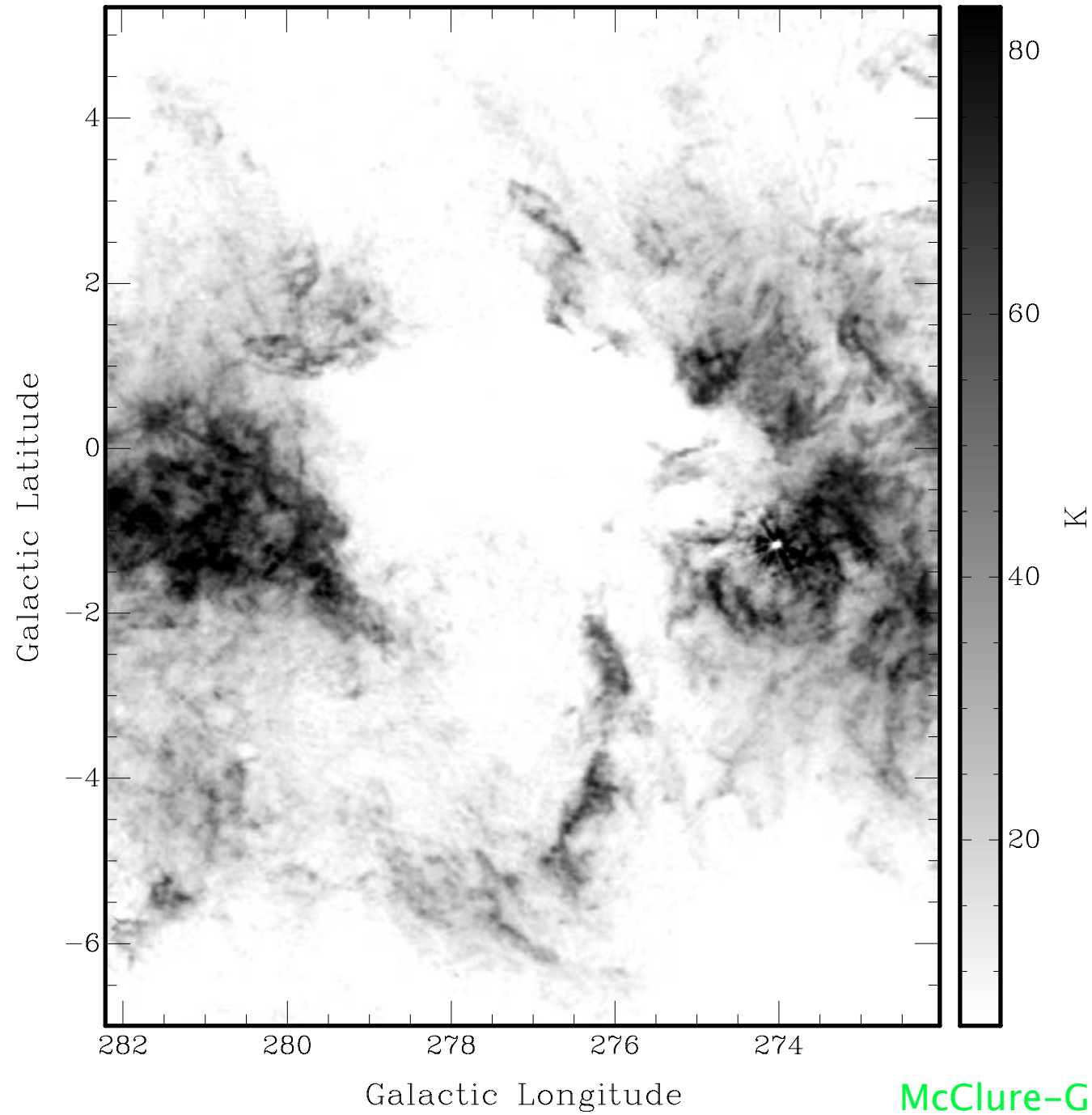




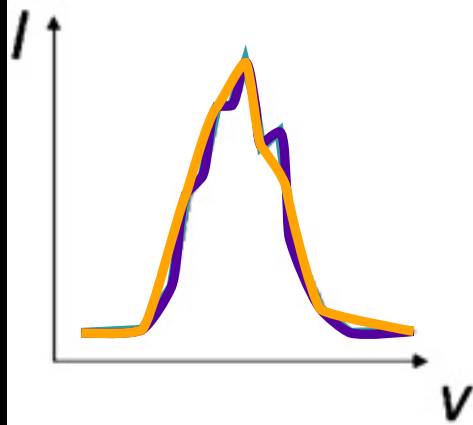




Velocity: 36.28 km/s



McClure-Griffiths+ 2009



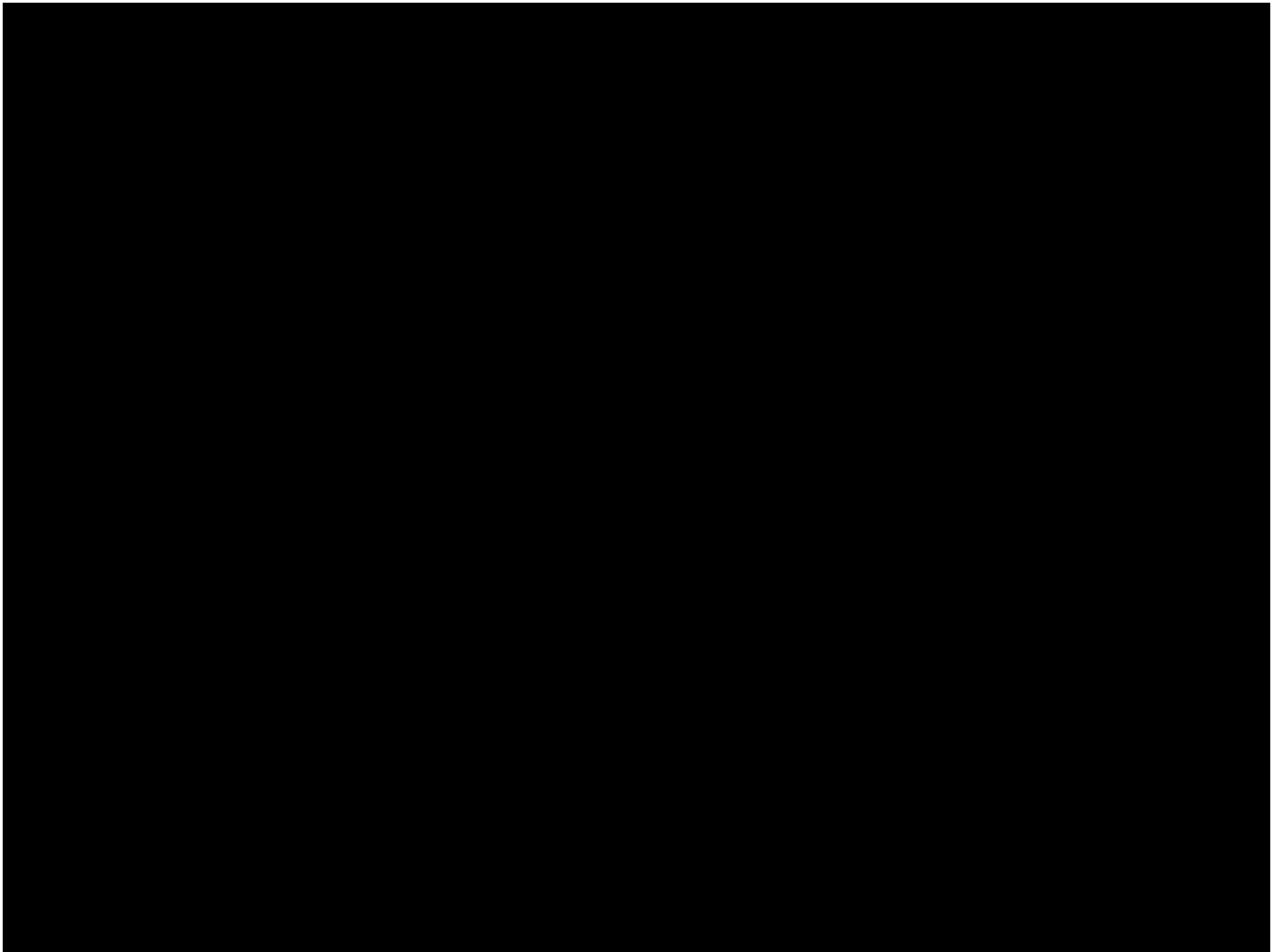
Instrument beam

Emitting structure

3

2

1



Objects in Space

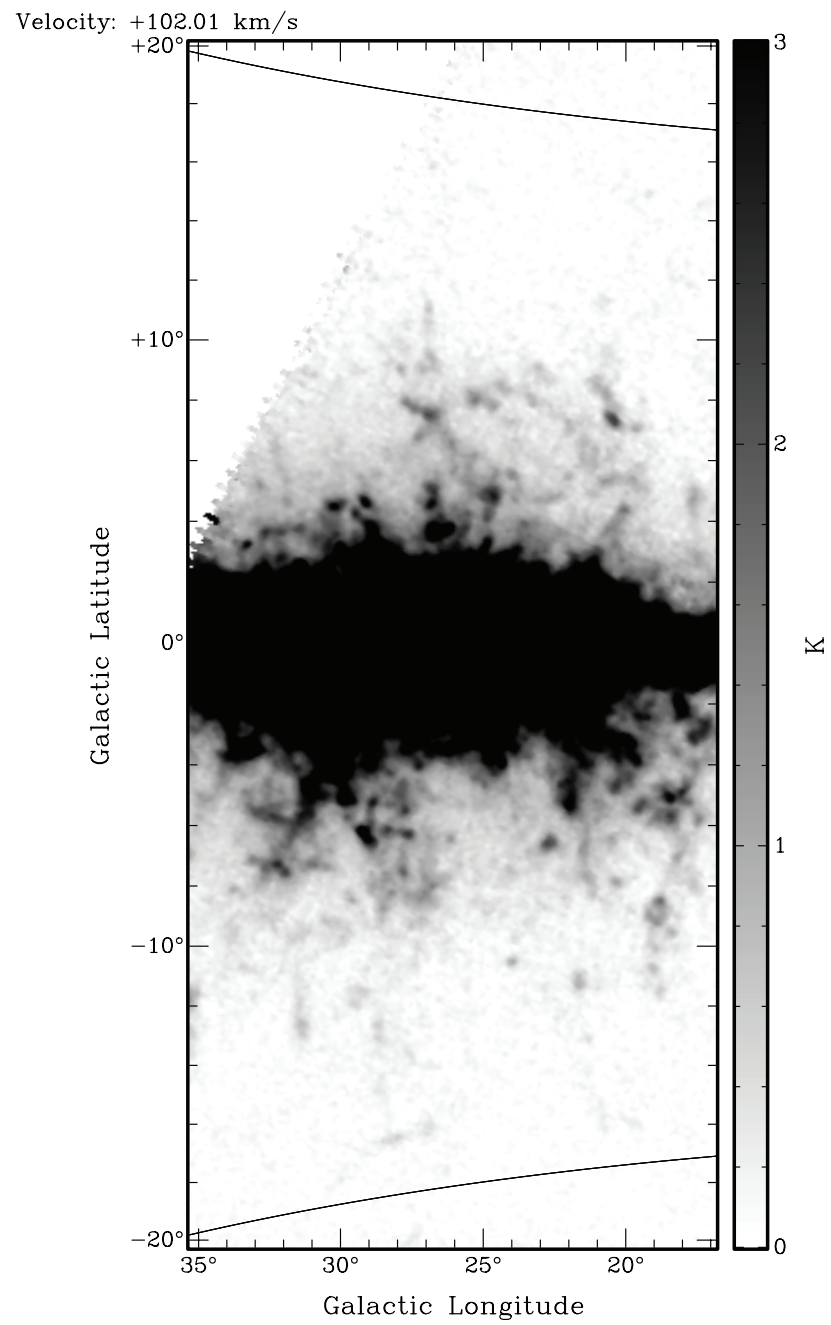
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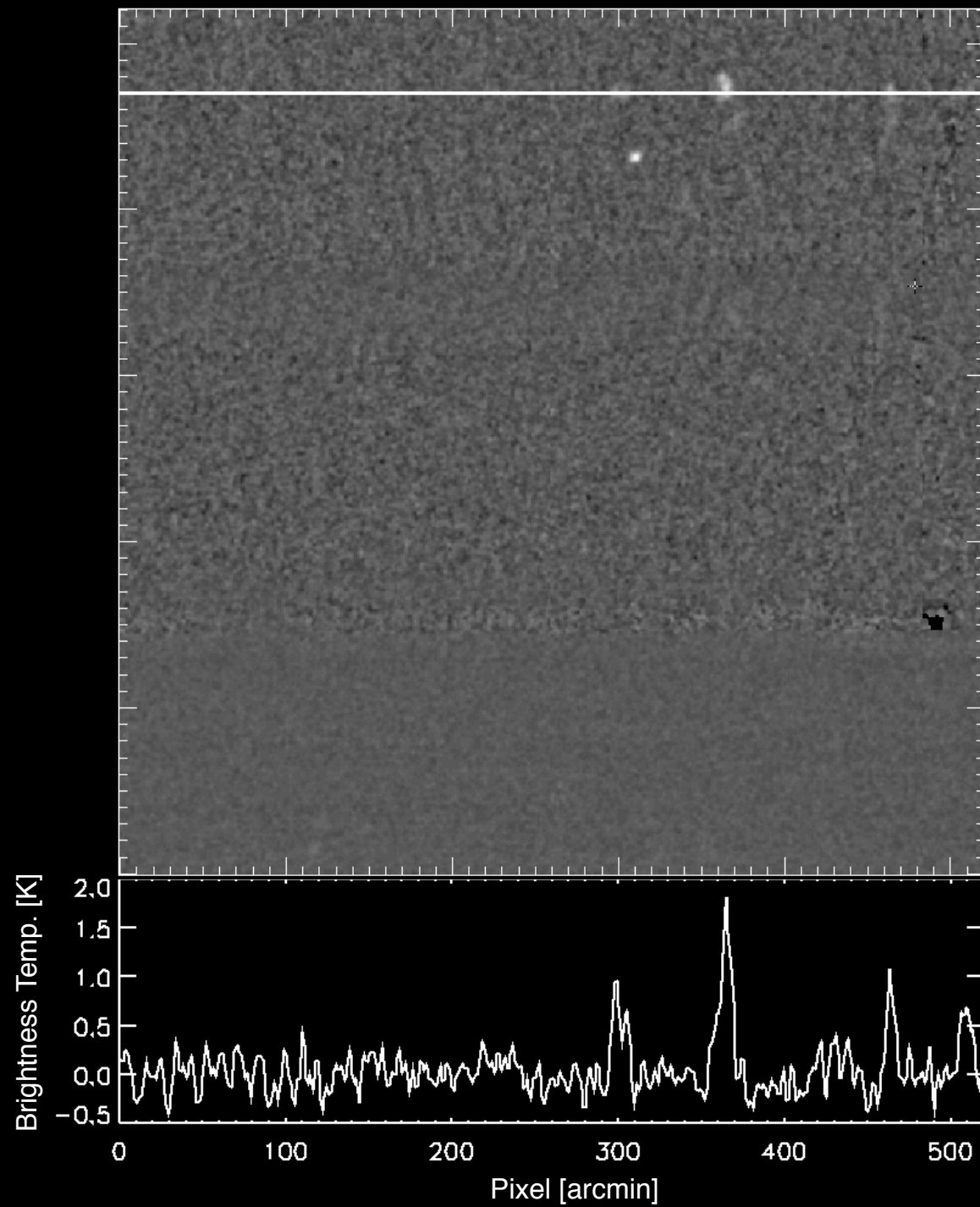
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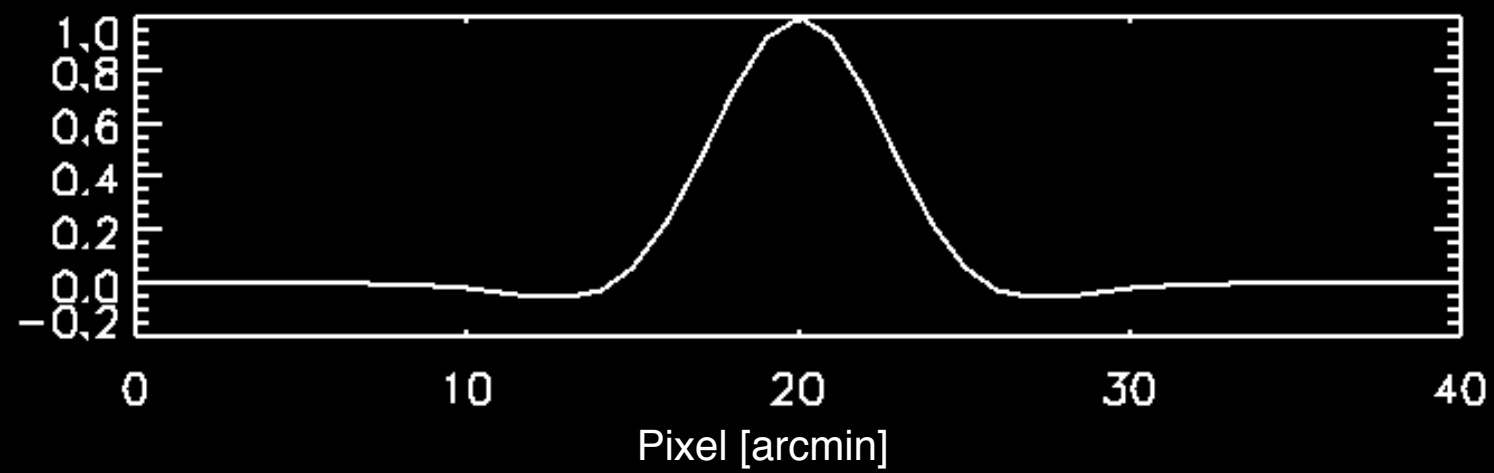
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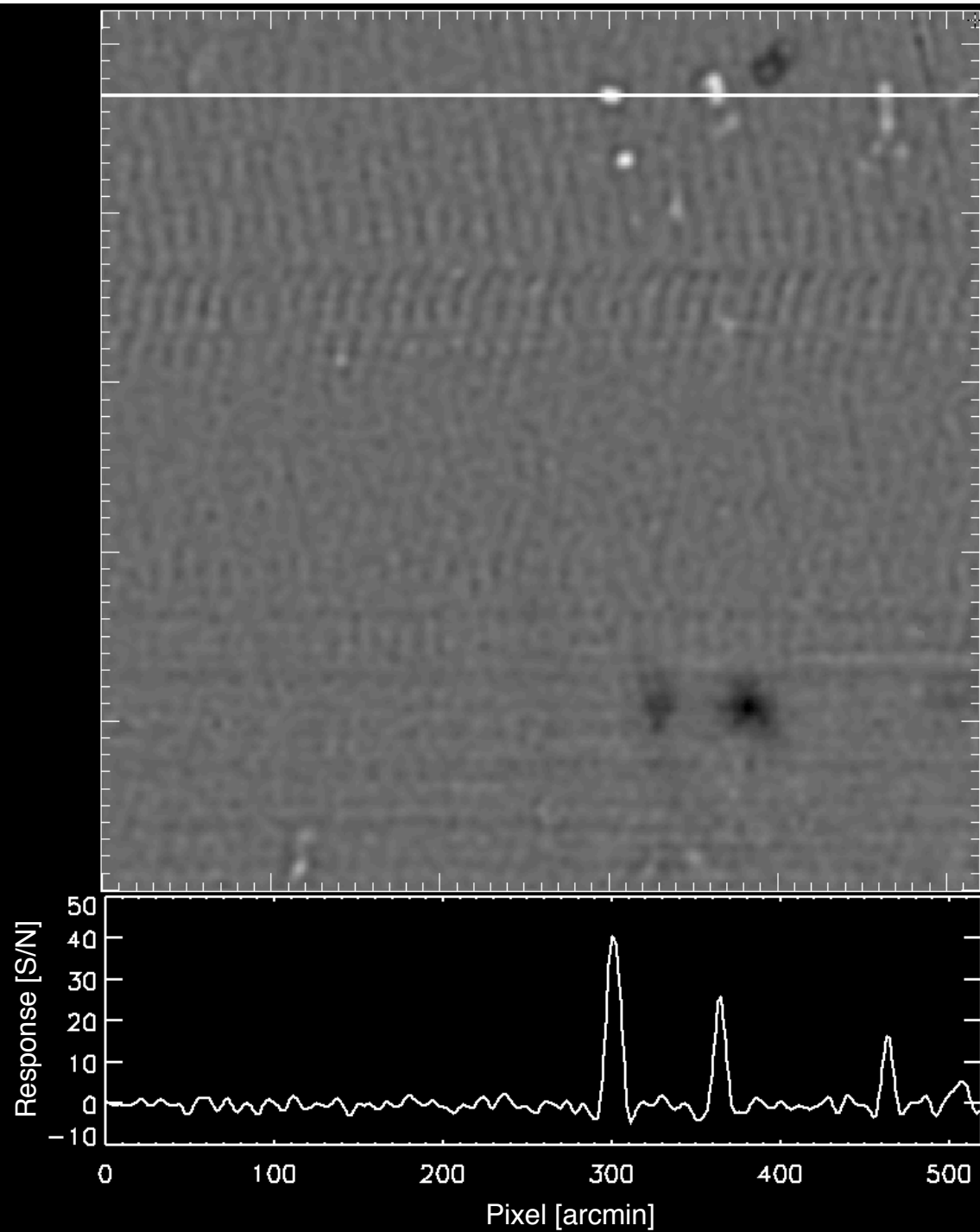
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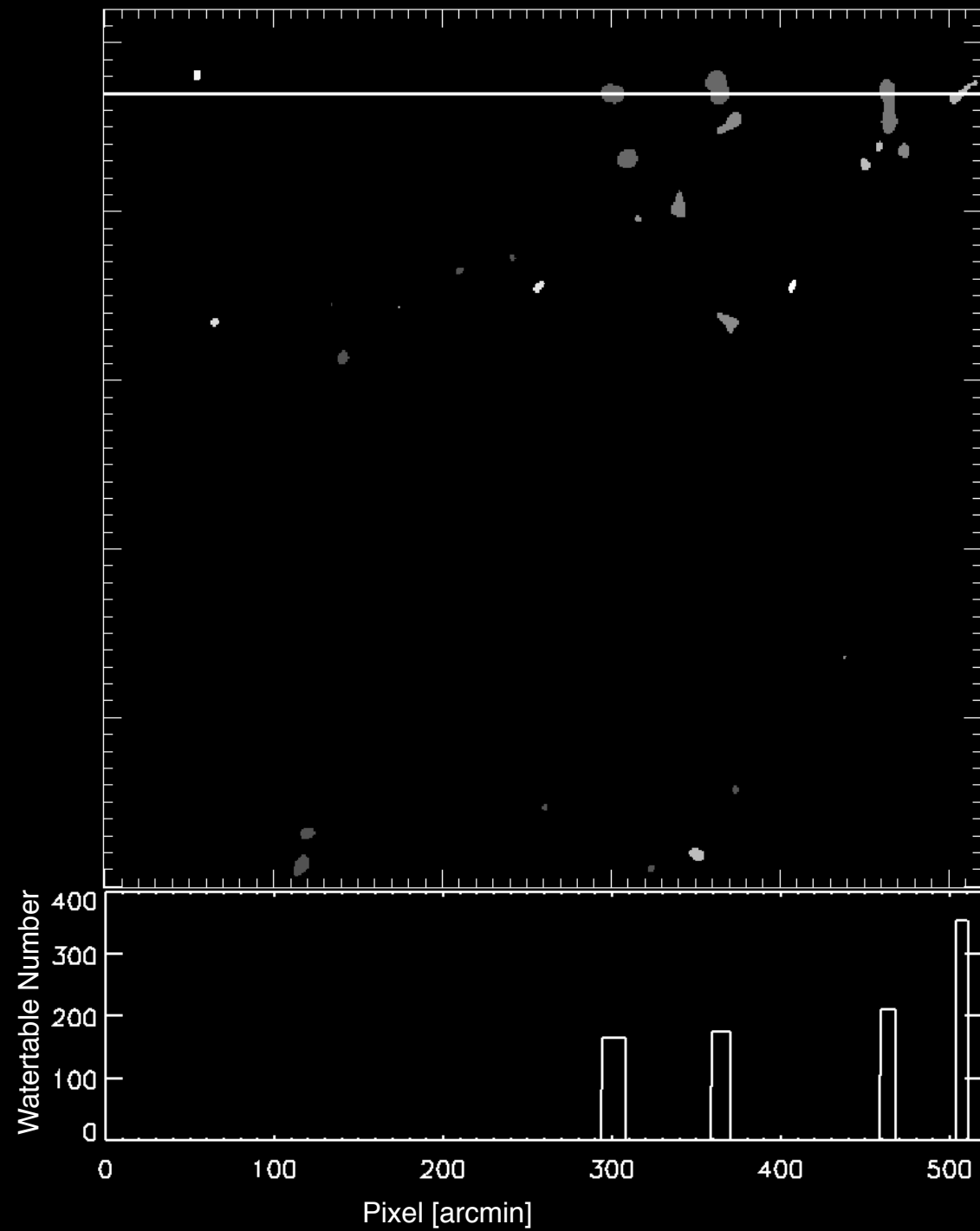


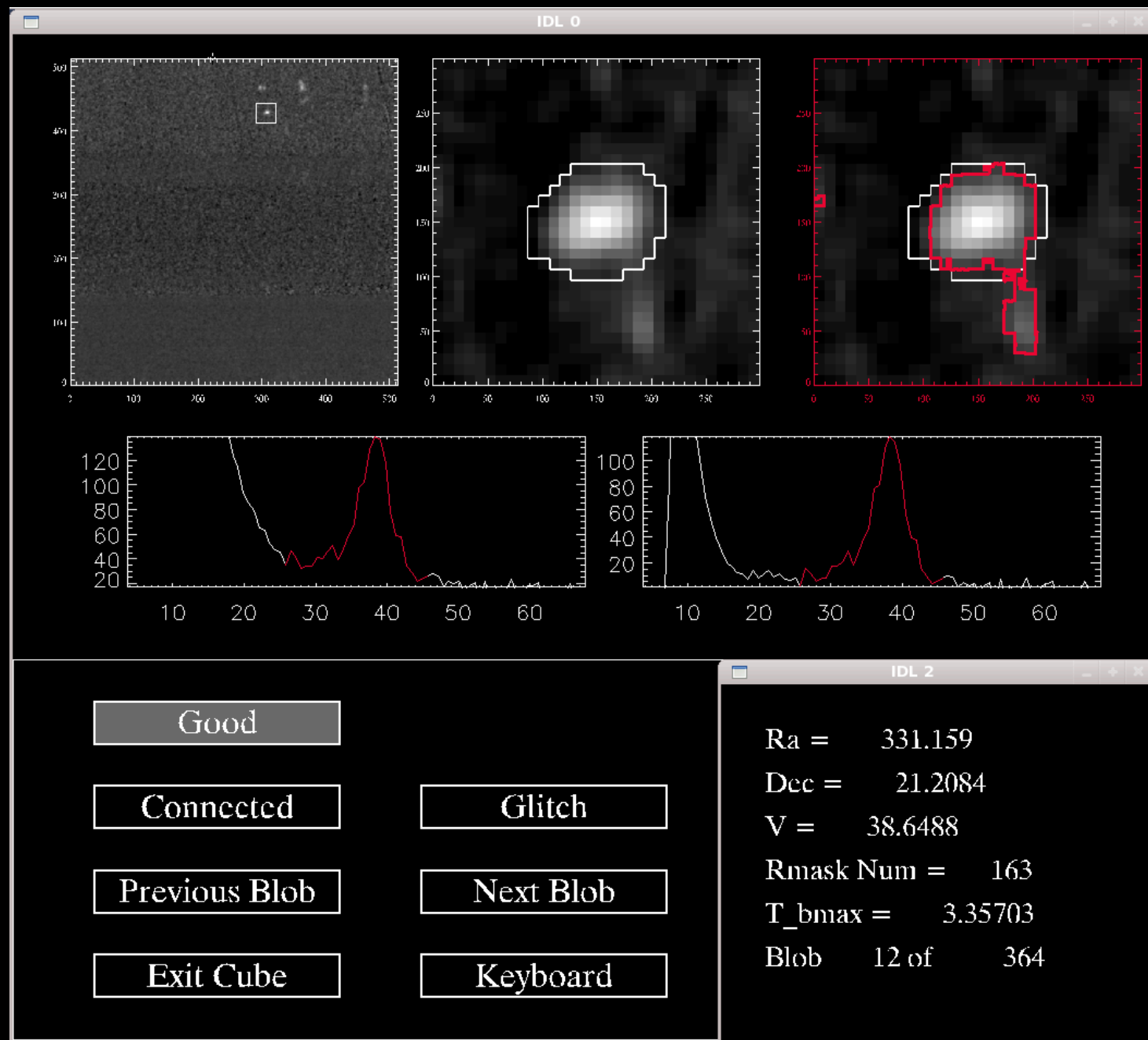


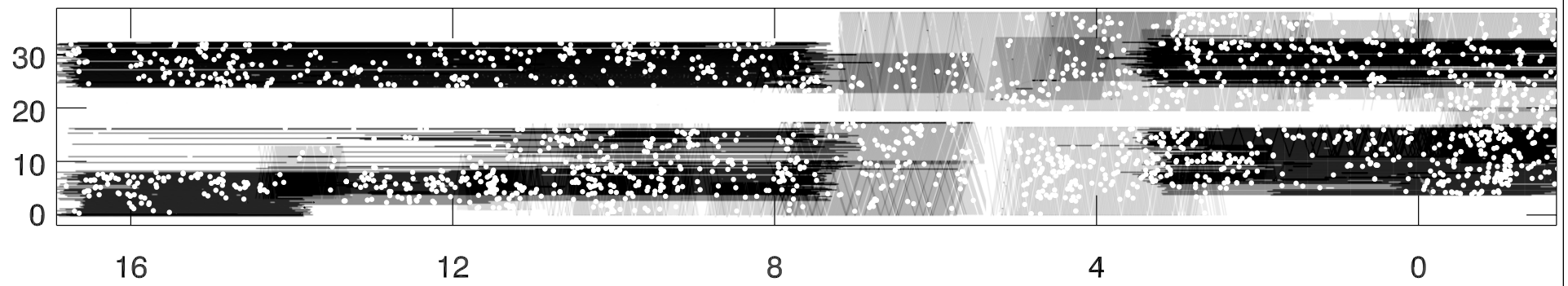




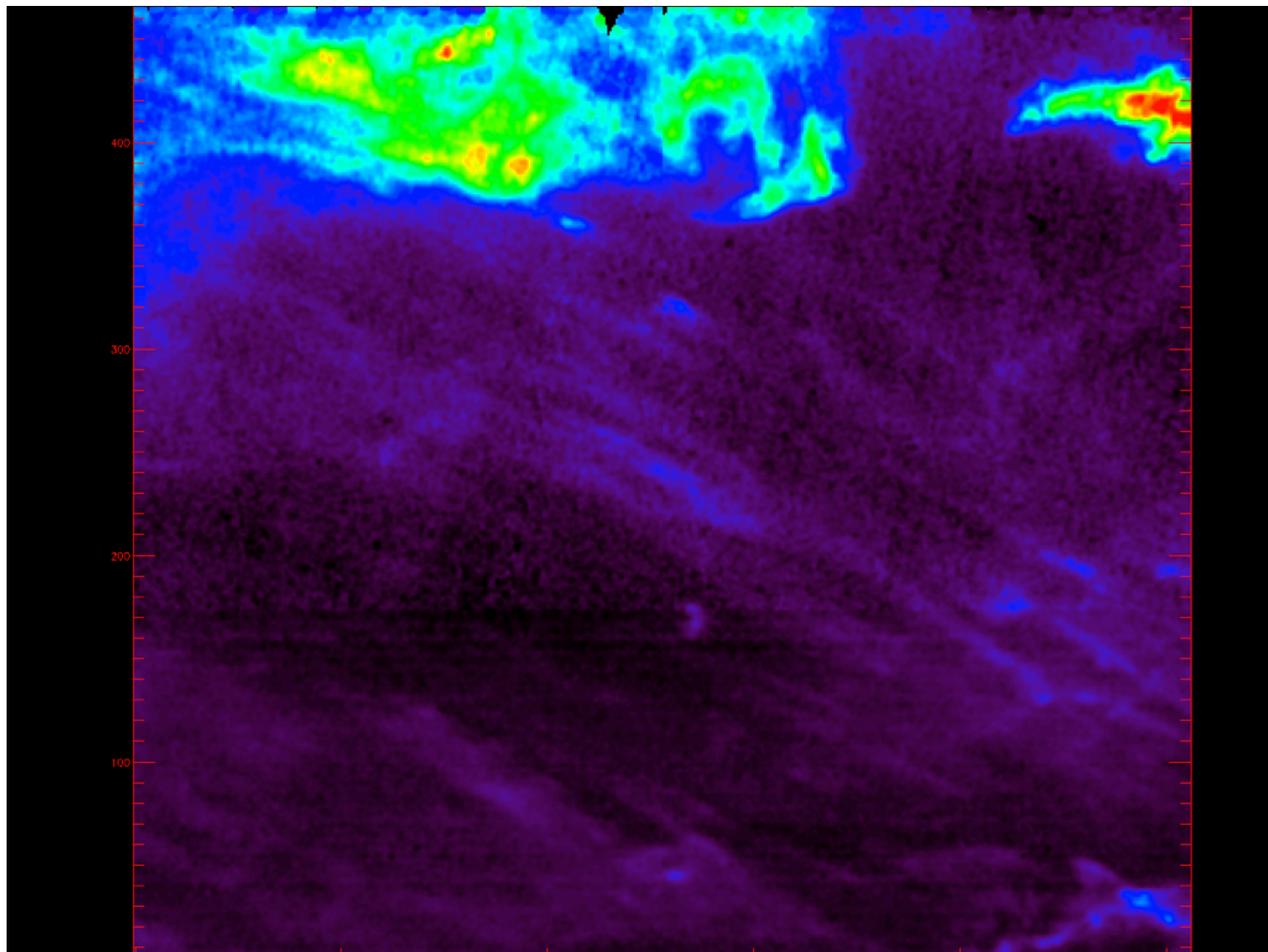
Saul+ 2011

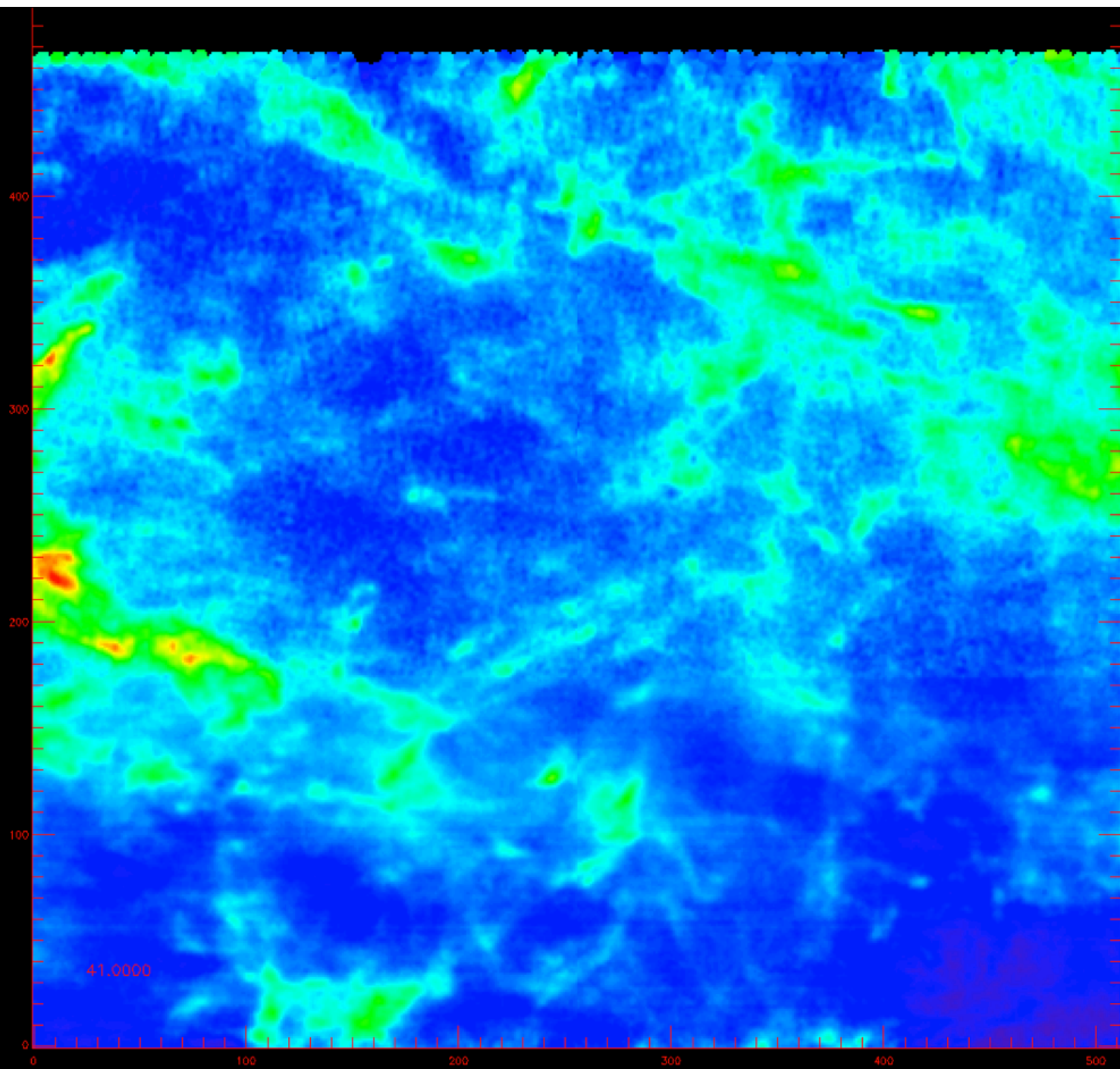


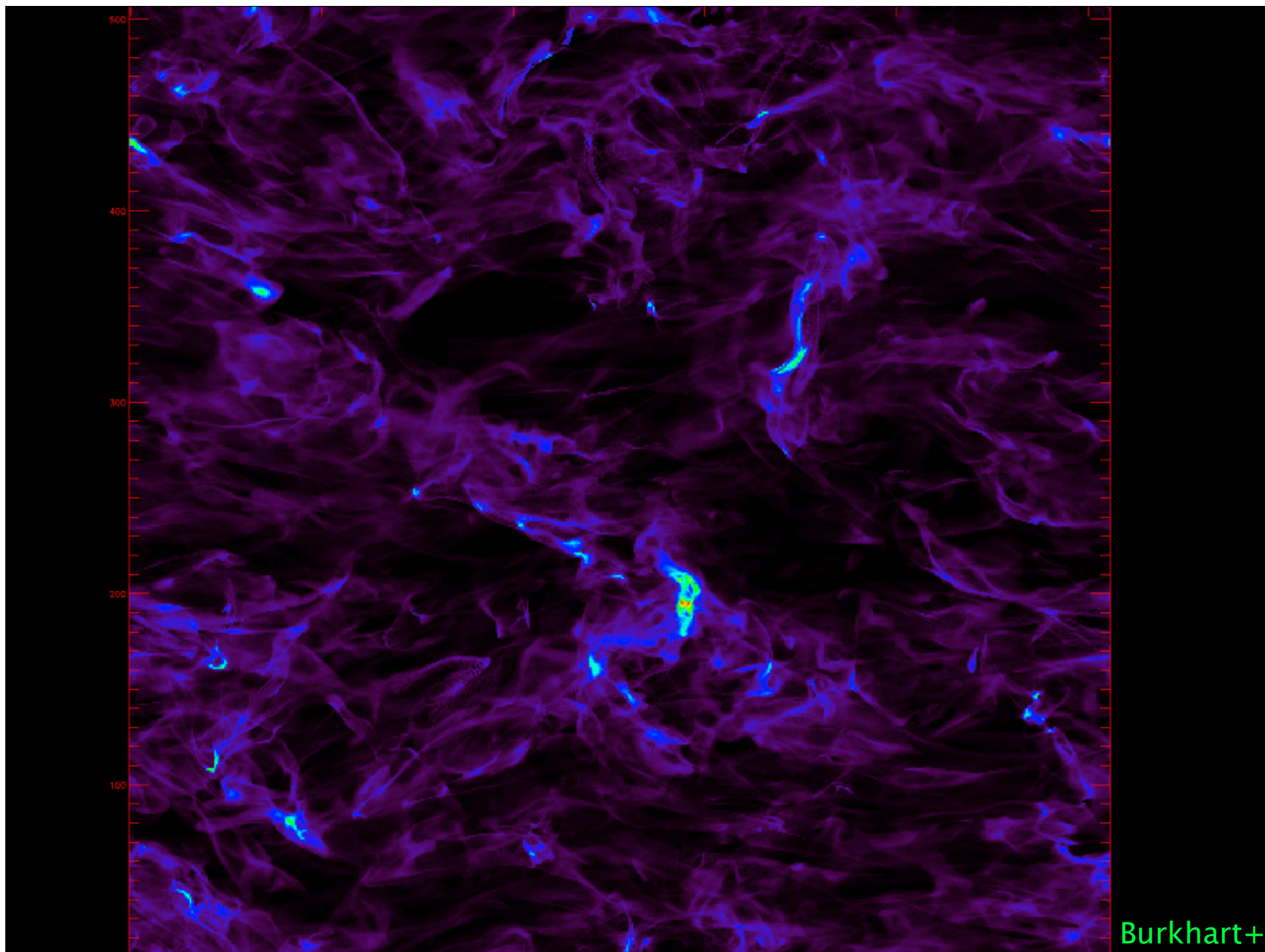












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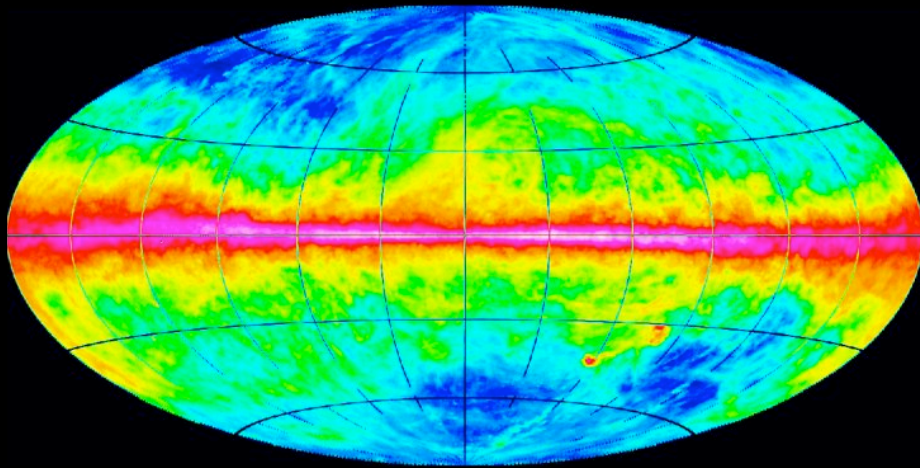
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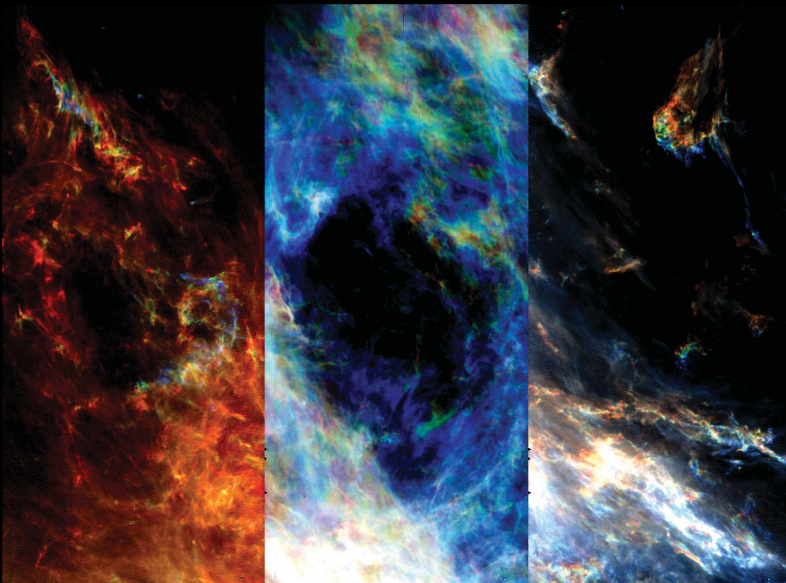
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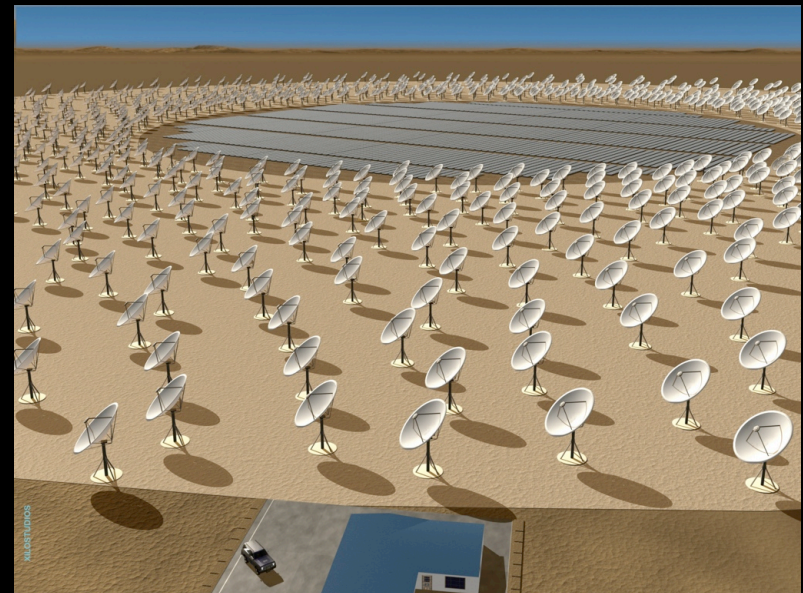
LAB: $\sim 10^2 \times \sim 10^2 \times 10^3$



GASKAP: $\sim 10^4 \times \sim 10^4 \times 2 \times 10^4$



GALFA-HI: $\sim 10^3 \times \sim 10^3 \times 10^4$



SKA: $\sim 10^5 \times \sim 10^5 \times 4 \times 10^4$